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ABSTRACT

This autoinstructional lesson deals with the study of genetics. It is a learning activity for so-called middle achievers in grade 10 biology classes. Previous knowledge of the process of mitosis and meiosis are important requirements. Behavioral objectives are suggested. Approximately 20 minutes are needed to complete the instructional unit. The equipment and materials necessary with the script are itemized in the packet. (EB)

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MONOHYBRID CROSS

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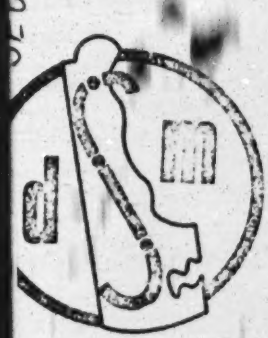
June 30, 1973



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A-T TEACHER'S GUIDE

Packet Number - AT H 581.158

Subject - Genetics

Title - Monohybrid Cross

Grade - 10

Level - Middle

Prerequisites - Previous knowledge of the process of mitosis and meiosis

Behavioral Objectives -

1. To be able to define homozygous, heterozygous, allele, dominant, recessive

2. To be able to predict results from a cross between a heterozygous and a homozygous adult

Equipment and Material -

Envelopes A, B, C
Six slides
Slide projector
Tape recorder
Cassette tape
Work sheet
Poster of objectives

Time - Approximately 20 minutes

Sample Evaluation - Work sheets

Space Required - Carrel

GENETICS: PART I
MONOHYBRID CROSS

Today you are going to learn some of the basic principles of genetics. Genetics is the study which explains how organisms inherit their physical characteristics. For instance, it shows why members of a family are apt to look more alike than strangers. Before you learn anything new, however, it is important that we review something you have already learned.

LOOK AT SLIDE ONE

We have mentioned meiosis several times this year. It is important to remember that in the nucleus of cells there are pairs of chromosomes - that is, two of each type. When sex cells are formed, one member of each pair enters each new sex cell. Therefore, if the cells of the animal you are studying has 4 chromosomes as shown here, each sex cell will have 2 or one of each pair. In this way, when 2 sex cells combine in reproduction, the new cell has the original number 4. In plants the eggs are the female sex cells and the pollen grain contains the male.

On the chromosomes are units called genes which determine the physical characteristics of an organism. Since you are a combination of thousands of traits, you have thousands of genes. You only have 46 chromosomes, however; therefore, there are many genes on each chromosome. In this lesson we are only concerned with one gene on one chromosome.

In pea plants there is a gene which determines whether the plant is tall or short. This is located on one of the chromosome pairs. Each member of this pair has either a unit for tallness or shortness.

In order to understand this more fully, remove the group of pipe cleaners in envelope A. Pair the red pipe cleaners together and the white ones together. This will represent the gene trait for plant height. There are 2 different colored beads because there are 2 different sizes that can be determined by this particular gene. Different expressions of the same trait are called alleles. In this case one allele makes a pea plant tall, the other makes a pea plant short. Let us say that the red beads are the alleles for tallness. Notice that the 2 red chromosomes each have a red allele. The plant that has this chromosome pair would be tall since the red beads are representing the tall allele. Notice that the 2 white chromosomes each have a blue bead. The plant that has this chromosome pair would be short since the blue beads are representing the short allele.

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page 2.

Now let's try another cross. PICK UP ENVELOPE B and remove the pipe cleaners. As before, pair the red ones together and the white together. You should notice that each pair has one chromosome with a red bead and one with a blue bead. What would be the height of these pea plants? The answer is tall. The red bead for tall is dominant over the blue bead for short. Now separate the pairs to represent the sex cells. From the red male set you should see that you can get pollen grains with the tall trait and ones with the short trait. The same is true for the eggs from the female. Now, by pairing one male chromosome with one female chromosome, determine how many combinations of offspring you can get. You should have gotten 4. Move the pipe cleaners as I speak so t at all these combinations are clear to you. You could pair the male red chromosome with the red bead with the female white chromosome with the red bead. This would give you two genes for tall - the plant would therefore be tall. If two chromosomes have identical genes they are said to be homozygous. The plant represented here is homozygous for the trait tall.

Another combination would be the red male chromosome with the blue bead and the white female chromosome with the blue bead. This combination would also be homozygous and the plant would be short. (For a third combination, pair the red male chromosome with the red bead and the white female chromosome with the blue bead. The plant would be tall since tall is dominant. The two traits shown here are not identical - one is for tall and one is for short. We call this heterozygous when the traits are different.)

The final combination would be the red chromosome with the bead and the white chromosome with the red bead. Is this plant tall or short? It is tall. Is it heterozygous or homozygous? It is heterozygous since it has 2 different traits.

Put the pipe cleaners back in the envelope and look at slide 4 which illustrates the cross we just did. The male and female plants are both tall. They are heterozygous since they both have one trait for tallness and one for shortness. The male can make pollen grains with "T" for tall and those with a "t" for short. These have been filled in on the chart below. The female can produce egg cells which also are either "T" or "t". They are filled in across the top of the square. Notice that the same four results are gotten as with the pipe cleaners. The one in the top left square is homozygous tall. The one in the bottom right is homozygous short. The other two are heterozygous and are tall. The results are shown below the square. These are 3 tall plants and one short one.

I would now like you to use what you have learned to work out some crosses. Remove the pipe cleaners from Envelope C. Select two pairs which you think correspond to the cross I describe. Select two chromosomes representing a homozygous recessive male. (PAUSE) You should have picked up two red pipe cleaners representing male. Each should have a blue bead representing the recessive trait short. Now select two chromosomes for a heterozygous female. (PAUSE) You should have two white chromosomes - one with a blue bead and one with a red bead. Now take one of the practice sheets from the pile. Fill in the cross as was done before. Stop the tape while you are working. (PAUSE)

Now look at slide 5. Compare your answer with the one shown. The homozygous male can only form pollen grains with a "t". The heterozygous female can form eggs which are either "T" or "t". When you work the cross you should get two heterozygous "Tt" correct answers. If necessary turn off the tape and study the slide more carefully. If you still have questions jot them down and bring them to your instructor. It is most important that you understand everything involved. If you are having trouble with the square, try this. Place your right forefinger on one of the egg cells and your left forefinger on one of the pollen grains. Now move your right finger down and your left finger across. In the square where your fingers meet write the letters in those two sex cells.

Now try another cross. From the group of pipe cleaners pick two that represent a homozygous dominant male. (PAUSE) You should have picked two red chromosomes with red beads. Now pick two that represent a heterozygous female. (PAUSE) You should have picked two white chromosomes - one with a red bead and one with a blue bead. Turn to the second practice sheet and fill in the cross as was done before. Stop the tape while you are working. (PAUSE) Now look at slide 6. Compare your answer with the one shown. The homozygous male can only form pollen grains with "T". The heterozygous female can form eggs which are either "T" or "t".

When you worked the cross you should have gotten two heterozygous "Tt" tall plants and two homozygous dominant tall plants. Fill in the correct answers. If necessary turn off the tape and study the slide more carefully. If you still have questions rerun the part of the tape that you don't understand or ask your instructor for help. Take the practice sheet with you when you go. This is for you to study from. The third sheet has a list of the vocabulary words you will be responsible for.

Make sure you become familiar with them. Now that you have finished, replace the pipe cleaners in envelope C. Leave the carrel as you found it for the next person. Stop the tape and rewind it.